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Technical Article 1

USE OF REMOTE SENSING DATA IN A WILDFIRE REHABILITATION PROJECT

by
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ABSTRACT

A variety of remotely sensed data proved useful in the rehabilitation of an area in central Oregon damaged by a forest fire. A team of U. S. Forest Service specialists used these data in developing an overview of burn intensity, site capability, and severity of vegetation damage. Large-scale aerial photography taken from a light plane, small-scale infrared U-2 photography, and Landsat digital data were all used in planning and implementing the re-establishment of vegetation cover, the construction of drainage control structures, and the salvage and removal of debris. Rehabilitation actions were completed in time to successfully avoid damage from summer thunderstorms and winter precipitation.

INTRODUCTION

Wildfire-damaged areas are extremely vulnerable to overland flow of water. Heavy rains and runoff cause loss of soil, degradation of water quality, and threats to life and property from flooding. Restoration of vegetation cover, construction of structures for drainage control, and residue treatment are among the actions which fire rehabilitation personnel must plan and implement before the first damaging precipitation. The immediate and short-term actions must be cost-effective, and must not interfere with the long-term management objectives for the area.

On July 24, 1979, a fire began on the eastern slopes of Oregon's Cascade Range within the Deschutes National Forest. Before the fire was controlled on July 28, 4,500 acres on steep terrain with highly erodible pumice/ash-derived soils were left without protective cover. A rehabilitation project was organized because: 1) there were extensive downstream capital improvements, 2) the area was a municipal watershed, 3) there was a predominance of hydrophobic soil types which would cause increased rates of runoff, 4) the steepness of the area would aggravate erosion, and 5) areas of relatively high inherent timber productivity were involved.

This paper describes the acquisition, analysis, and application of remotely sensed data in planning and implementing rehabilitation of the burned area.

METHODS

Pre-Fire Condition Analysis

An immediate inventory of the available remotely sensed data over the fire area was conducted. Three types of aerial photography were available: 1) high altitude, 1:130,000 9x9" color infrared (CIR) positive transparencies acquired by a NASA U-2 flight on August 2, 1978; 2) 9x18" CIR 1:32,000 positives acquired by a NASA U-2 flight on August 7, 1972; and 3) black and white 1:32,000 diazo positives from original coverage contracted by the Oregon Department of Forestry. In many cases, the larger-scale CIR coverage provided enough detail for species determination, and the more recently acquired small-scale CIR coverage served to update the older coverage for timber harvesting, road building, and the establishment and growth of reproduction stands during the 1972-78 interim. The black and white diazo positives served as inexpensive (30¢ each) copies for flight route mapping and field notes. Landsat multispectral scanner (MSS) digital data were

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also on hand from a June 8, 1978 overflight. Processing of these data commenced immediately, and was completed 36 hours later. Most of the pre-fire condition analysis was completed prior to final control of the fire.

The aerial photography was interpreted to determine type, condition, and structure of pre-fire vegetation. Management practices and cultural features were noted, tree species or species groups were outlined, and vegetation densities were estimated. The complexity of cover was examined, and the presence or absence of understory vegetation was determined for most forested areas. Satellite data were analyzed to develop a quantitative overview of the extent and location of various cover classes. An overlay incorporating cultural features to aid in the location of specific ground areas on the digital printout was also constructed. Interpretation of these materials permitted the delineation of the distribution, abundance, and condition of various indicator species before the burn (Volland 1976; Franklin and Dyrness 1973) and allowed informed inferences to be drawn about such site characteristics as soil depth, texture, and waterholding capacity.

Post-Fire Analysis

To obtain a detailed record of the extent and severity of the burn, photographic data were acquired at the earliest possible date after the fire. Three days after the fire was controlled, complete coverage of the burned area was acquired on 35 mm CIR film. Near-vertical or low oblique photographs were used in assessing the condition of vegetation and, in particular, for predicting likelihood of tree survival. Vertical 35 mm natural color photography was obtained during the same flight, and developed prints were used to produce large-scale mosaics of the entire burned area.

USE OF EXTRACTED INFORMATION

Project results were put to use immediately. Some emergency rehabilitation work began utilizing fire control crews before demobilization. Some fire equipment was immediately available for rehabilitation work. Planning for contract labor and specialized tasks was also initiated immediately upon control of the fire. Since the fire site was within a zone where summer thunderstorms are common, there was no time to waste in completing the required rehabilitation work before the first damaging rainfall. Information essential to the planning and direction of this work had to be supplied quickly.

At the same time that photography was being exposed and processed, ground crews were obtaining data on sample plots, measuring vegetation survival, amounts of litter left on the soil surface, fire effects on the humus layer, and soil wettability. Guided by pre-fire condition data, site descriptions were developed for homogeneous regions within the fire. Cambium layers of damaged trees were examined to determine whether sap was flowing. This permitted informed guesses about likelihood of survival and produced an index for a wide range of fire damage severity. Upon completion of the processing of post-fire photography, the ground data were used in interpreting extent and severity of damage. Ground-checked trees were located on the CIR photographs, and their signatures were used in predicting survival of damaged trees. Surviving trees were considered parent stocks; dead trees were salvaged or treated as required.

Many standing dead snags were left after the fire. Where logging methods compatible with minimal disturbance of soils could be employed, considerable volumes of marketable wood were found to be salvageable. In some areas snags represented potential hazards, as material for stream jamming and subsequent flooding, or as waterborne debris which would damage control impoundments or downstream capital improvements. In other areas, snags were used as the primary material for construction of contour terraces to break up flow and collect silt deposits. Areas with standing dead snags were easily located on natural color 35 mm 3R prints. By examining topographic relief on USGS quadrangle sheets, species composition on pre-fire photography and satellite digital images, and the extent of homogeneous areas, plans were made for logging, snag felling, and snag removal. Salvage sale units for logging of snags by helicopter were delineated. Assignment of snag-felling crews of a size appropriate to the area to be treated were made. Channels where snags and debris showed a potential for jamming were located. The material was then burned or otherwise removed. The combined use of pre- and post-fire condition information, along with the ability to quickly quantify the areal extent of homogeneous areas from digital satellite images, permitted quick and efficient planning and allocation of the work effort in snag treatment.

Grass seeding was required on most sites which had burned with high intensity. In general, this type of burn occurred within dense stands, most of which were mixed conifer. To identify and quantify the extent of areas to be seeded, the pre-fire digital image was used as the primary information source. By studying acreage tabulations for the pre-fire condition, estimates of grass-seeding acreages were calculated and used in contracting for custom helicopter seeding. Contract seeding of 1,600 burned acres began eight days after control of the fire.

Basins to capture larger volumes of silt and debris than could be held by snag terraces were required along ravines and intermittent streams. The placement of these impoundments was aided by the use of materials mentioned above. More efficient assignments of tractors and crews were made possible by pre-identifying potential basin sites.

CONCLUSION

A series of potentially damaging thunderstorms passed over the fire area during the late summer and fall of 1979. At the Bend municipal water intake, the only measurable effect of the storms was a slight increase in suspended ash particulates, which was not considered significant. Most debris basins filled to capacity but none were broached. Many contour snag terraces filled to capacity and diversions of flows were successful in avoiding significant damage to trails, roads, and other improvements. By the time of the storm, grass seedlings had established sufficiently to protect the soil surface. In short, all emergency actions were completed in time to avert any significant damage.

ACKNOWLEDGMENT

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REFERENCES

Franklin, J. F., and Dyrness, C. F. Natural Vegetation of Oregon and Washington. USDA Forest Service General Technical Report PNW-8.

Volland, Leonard A. 1976. Plant Communities of the Central Oregon Pumice Zone. USDA Forest Service, Pacific Northwest Region, Region 6 Area Guide 4-2.

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Technical Article 2

COMPUTER PROGRAM FOR POINT-SAMPLE BIOMASS CRUISING OF APPALACHIAN HARDWOODS

by
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and
Dan E. Wingerd[1]

ABSTRACT

A FORTRAN computer program is provided to give per-acre and tract estimates of total and merchantable green and dry biomass with sampling errors for point-sample cruises of Appalachian hardwood stands. Cordwood estimates are included also. Field work requires only the recording by species of heights of point-sample-selected trees.

[1]The authors are professor of forestry and graduate student, respectively, Division of Forestry, West Virginia University, Morgantown, WV 26506. WVU Agr. and Forest Exp. Stn. Sci. Paper 1658.

INTRODUCTION

Biomass factors for point sampling of Appalachian hardwoods have recently been developed by Wiant and Wingerd (in press). That report gives the rationale and methoodology used and point-sampling biomass factors for northern red oak (NRO), black oak (BO), scarlet oak (SO), white oak (WO), chestnut oak (CO), hickories (HIC), yellow-poplar (YP), black cherry (BC), red maple (M), and all of these species combined (OTHERS). Field work involves recording total heights of point-sample-selected trees. (Although not preferred as the predictions are not as reliable, merchantable height to a 4-inch diameter outside bark may be recorded if the canopy obscures the total height.) Heights are recorded by species, using OTHERS for miscellaneous species unless they are included in the tally of a similar species (as cucumbertree with YP). Table 1 gives a listing of the FORTRAN program, and details on use of this system are given in the following sections.

Table. 1. FORTRAN program listing.

```
      DIMENSION TABEL(12,8),GTABEL(12,8),VALUE1(10),VALUE2(10),
     2 FACTR1(60),FACTR2(60),LABEL(10),SUM(8),PER(8),CV(8)
      DOUBLE PRECISION LABEL
      DATA GTABEL/96*0./,KOUNT/0/,SUM/8*0./
      DATA LABEL/'NRO','BO','SO','WO','CO','HIC','YP','BC','M','OTHERS'/
      DATA FACTR1/361.,365.,380.,349.,385.,355.,264.,318.,333.,344.,
     2            207.,208.,220.,196.,228.,230.,137.,184.,184.,198.,
     3            177.,173.,190.,171.,192.,205.,116.,166.,162.,171.,
     4            277.,276.,293.,284.,304.,271.,230.,266.,264.,273.,
     5            158.,156.,166.,160.,181.,176.,121.,156.,146.,157.,
     6            137.,132.,146.,143.,155.,159.,103.,141.,130.,138./
      DATA FACTR2/523.,539.,539.,485.,592.,500.,392.,443.,482.,493.,
     2            300.,308.,312.,273.,327.,325.,204.,258.,266.,284.,
     3            256.,255.,270.,238.,275.,291.,173.,232.,234.,245.,
     4            402.,408.,416.,395.,434.,382.,342.,371.,381.,392.,
     5            229.,231.,236.,222.,258.,249.,180.,218.,212.,225.,
     6            198.,194.,207.,199.,221.,225.,154.,197.,189.,197./
   10 FORMAT(F4.0,I5,F6.0,1X,I1)
   11 FORMAT(I4,10F4.0/4X,10F4.0)
   20 FORMAT('1')
   21 FORMAT(///1X,'PER-ACRE BIOMASS ESTIMATES (TONS) FOR POINT SAMPLE N
     20.',I5//22X,'TOTAL',26X,'MERCH.'/1X,'SPECIES',3X,2('GREEN',
     3 3X,'DRY',2X,'W/O BARK',2X,'BARK',4X)/)
   22 FORMAT(/2X,A8,1X,2(F5.1,2X,F5.1,2X,F5.1,3X,F5.1,3X))
   23 FORMAT(//2X,'TOTALS',3X,2(F5.1,2X,F5.1,2X,F5.1,3X,F5.1,3X)///
     2 2X,'CORDS',4X,F5.1,25X,F5.1)
   60 FORMAT('1'///1X,'PER-ACRE BIOMASS ESTIMATES (TONS) FOR CRUISE'//
     2 22X,'TOTAL',26X,'MERCH.'/1X,'SPECIES',3X,2('GREEN',3X,
     3 'DRY',2X,'W/O BARK',2X,'BARK',4X)/)
   61 FORMAT(///2X,'NO. POINT SAMPLES =',I5///2X,'NO. ACRES IN TRACT =',
     2 F7.1)
   50 FORMAT('1'///1X,'TOTAL BIOMASS ESTIMATES (TONS) FOR THE TRACT')
   51 FORMAT(//1X,'SPECIES',6X,'GREEN',7X,'DRY',8X,'W/O BARK',5X,'BARK'
     2/)
   53 FORMAT(/2X,A8,1X,4(F10.1,2X)/)
   54 FORMAT(//1X,'TOTALS',3X,4(F11.1,1X)///1X,'STD ERROR',
     2 4(F11.1,1X)/3X,'PERCENT',6X,4(F5.1,7X)//1X,'CO VAR(%)',4(F11.1,
     3 1X)///2X,'CORDS',3X,F11.1,///2X,'NO. POINT SAMPLES =',I5///2X,
     4 'NO. ACRES IN TRACT =',F7.1)
   55 FORMAT('1'///1X,'MERCH. BIOMASS ESTIMATES (TONS) FOR THE TRACT')
  401 FORMAT(/2X,'**ERROR** OPTION CARD CONTAINS INAPPROPRIATE UNITS OF
     2MEASURE'/2X,'PROBABLE CAUSE : MISSING VALUES FOR NUMBER OF POINTS
     3OR ACRES')
  402 FORMAT('1'//5X,'NORMAL TERMINATION EXIT')
      READ(5,10) BAF,NOPTS,ACRES,IOPT1
      IF(BAF.EQ.10..OR.BAF.EQ.0.) GO TO 100
      ADJUST=BAF/10.
      DO 110 I=1,60
       FACTR1(I)=FACTR1(I)*ADJUST
  110  FACTR2(I)=FACTR2(I)*ADJUST
  100 READ(5,11) IPOINT,(VALUE1(I),VALUE2(I),I=1,10)
      IF(IPOINT.EQ.9999) GO TO 499
      DO 199 I=1,8
  199  TABEL(11,I)=0.
      DO 200 I=1,6
       DO 200 J=1,10
        K=J+(10*(I-1))
        TABEL(J,I)=(FACTR1(K)*VALUE1(J)+FACTR2(K)*VALUE2(J))/2000.
  200   GTABEL(J,I)=GTABEL(J,I)+TABEL(J,I)
      DO 201 I=1,10
       TABEL(I,7)=TABEL(I,2)-TABEL(I,3)
       TABEL(I,8)=TABEL(I,5)-TABEL(I,6)
       GTABEL(I,7)=GTABEL(I,7)+TABEL(I,7)
  201  GTABEL(I,8)=GTABEL(I,8)+TABEL(I,8)
      DO 202 I=1,8
       DO 203 J=1,10
  203   TABEL(11,I)=TABEL(11,I)+TABEL(J,I)
  202  TABEL(12,I)=TABEL(11,I)**2
      DO 204 I=1,8
  204  SUM(I)=SUM(I)+TABEL(12,I)
      IF(IOPT1.NE.1) GO TO 100
```

```
      CORD1=TABEL(11,1)/2.9045
      CORD2=TABEL(11,4)/2.9045
      IF(KOUNT.NE.2) GO TO 220
      WRITE(6,20)
      KOUNT=0
  220 WRITE(6,21) IPOINT
      DO 221 I=1,10
  221 WRITE(6,22) LABEL(I),(TABEL(I,J),J=1,3),TABEL(I,7),
     2 (TABEL(I,J),J=4,6),TABEL(I,8)
      WRITE(6,23) (TABEL(11,J),J=1,3),TABEL(11,7),
     2 (TABEL(11,K),K=4,6),TABEL(11,8),CORD1,CORD2
      KOUNT=KOUNT+1
      GO TO 100
  499 IF(NOPTS.EQ.0.OR.ACRES.EQ.0.) GO TO 400
      GO TO 500
  400 WRITE(6,401)
      GO TO 450
  500 XN=FLOAT(NOPTS)
      XXN=FLOAT(NOPTS-1)
      DO 501 I=1,8
       DO 502 J=1,10
  502   GTABEL(11,I)=GTABEL(11,I)+GTABEL(J,I)
  501  GTABEL(12,I)=GTABEL(11,I)**2
      DO 503 I=1,8
       DO 503 J=1,11
  503   GTABEL(J,I)=GTABEL(J,I)/XN
      DO 504 I=1,8
       IF(SUM(I).EQ.0.) GO TO 504
      SUM(I)=SQRT((SUM(I)-(GTABEL(12,I)/XN))/(XN*XXN))
      CV(I)=(SUM(I)*SQRT(XN))/GTABEL(11,I)*100.
  504  PER(I)=SUM(I)/GTABEL(11,I)*100.
      CORDS1=GTABEL(11,1)/2.9045
      CORDS2=GTABEL(11,4)/2.9045
      WRITE(6,60)
      DO 505 I=1,10
  505 WRITE(6,22) LABEL(I),(GTABEL(I,J),J=1,3),GTABEL(I,7),
     2 (GTABEL(I,K),K=4,6),GTABEL(I,8)
      WRITE(6,23) (GTABEL(11,J),J=1,3),GTABEL(11,7),(GTABEL(11,K),K=4,6)
     2 ,GTABEL(11,8),CORDS1,CORDS2
      WRITE(6,61) NOPTS,ACRES
      DO 506 I=1,8
       DO 507 J=1,11
  507   GTABEL(J,I)=GTABEL(J,I)*ACRES
  506  SUM(I)=SUM(I)*ACRES
      CORDS1=CORDS1*ACRES
      CORDS2=CORDS2*ACRES
      WRITE(6,50)
      WRITE(6,51)
      DO 52 I=1,10
   52 WRITE(6,53) LABEL(I),(GTABEL(I,J),J=1,3),GTABEL(I,7)
      WRITE(6,54) (GTABEL(11,J),J=1,3),GTABEL(11,7),
     2 (SUM(I),I=1,3),SUM(7),(PER(K),K=1,3),PER(7),(CV(L),L=1,3),CV(7),
     3 CORDS1,NOPTS,ACRES
      WRITE(6,55)
      WRITE(6,51)
      DO 56 I=1,10
   56 WRITE(6,53) LABEL(I),(GTABEL(I,J),J=4,6),GTABEL(I,8)
      WRITE(6,54) (GTABEL(11,J),J=4,6),GTABEL(11,8),(SUM(I),I=4,6),
     2 SUM(8),(PER(K),K=4,6),PER(8),(CV(L),L=4,6),CV(8),CORDS2,NOPTS,
     3 ACRES
      WRITE(6,402)
  450 STOP
      END
```

Field Tally

The field tally sheet should be designed so that keypunching can be done directly from it. Each point sample requires two data cards, with the point-sample number recorded in columns 1-4. Total or merchantable heights to the nearest foot, or more likely to the nearest 5 feet, are recorded without decimal points and right justified (two 50-foot NRO in-trees would be recorded as 100) as follows:

	Species	Column numbers: Total height	Column numbers: Merch. height
Card 1	NRO	5-8	9-12
	BO	13-16	17-20
	SO	21-24	25-28
	WO	29-32	33-36
	CO	37-40	41-44
Card 2	HIC	5-8	9-12
	YP	13-16	17-20
	BC	21-24	25-28
	M	29-32	33-36
	OTHERS	37-40	41-44

Fields with no data are left blank.

Options

One card is used to indicate options desired, as follows:

Item	Columns
BAF used, right justified if no decimal included. (If blank or zero, BAF = 10 assumed.)	1-4
Total number of point samples in cruise, right justified. (An error message is given if this value is not input or is zero.)	5-9
Total acres in tract, right justified if no decimal included.	10-15
If output for each individual point is desired, punch "1"; if not desired, leave blank.	17

General Instructions

The order of the cards to run this program is:

(1) JCL required at installation

(2) FORTRAN program

(3) Option card

(4) Point sample data cards

(5) Two cards punched 9999 in columns 1-4

Output

The output is given under the following headings:

TOTAL GREEN = fresh-weight biomass (tons) of trees, excluding ½-foot stumps, roots, and leaves.

TOTAL DRY = dry-weight biomass corresponding to TOTAL GREEN.

TOTAL W/O BARK = total dry-weight biomass, excluding bark.

TOTAL BARK = TOTAL DRY minus TOTAL W/O BARK.

MERCH. GREEN, DRY, W/O BARK, BARK = correspond to total values but to a 4-inch diameter outside bark.

Cords are calculated on the basis of 5809 pounds of green weight per cord (Wiant and Wingerd, in press). The difference in TOTAL GREEN and MERCH. GREEN biomass or cords represents an estimate of the increase in yield of whole-tree chipping over conventional pulpwood harvesting.

Table 2 shows the optional output which can be printed for each point sample. Table 3 gives

Table 2. Optional output for each point sample.

PER-ACRE BIOMASS ESTIMATES (TONS) FOR POINT SAMPLE NO. 3

	TOTAL				MERCH.			
SPECIES	GREEN	DRY	W/O BARK	BARK	GREEN	DRY	W/O BARK	BARK
NRO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HIC	21.0	13.6	12.2	1.5	16.0	10.4	9.4	1.0
YP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BC	6.4	3.7	3.3	0.4	5.3	3.1	2.8	0.3
M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	20.1	11.6	10.0	1.6	15.9	9.2	8.0	1.1
TOTALS	47.4	28.9	25.5	3.4	37.3	22.7	20.3	2.4
CORDS	16.3				12.8			

Table 4. Total biomass estimates for the tract.

TOTAL BIOMASS ESTIMATES (TONS) FOR THE TRACT

SPECIES	GREEN	DRY	W/O BARK	BARK
NRO	33.1	19.0	16.2	2.7
BO	0.0	0.0	0.0	0.0
SO	0.0	0.0	0.0	0.0
WO	17.4	9.8	8.5	1.3
CO	0.0	0.0	0.0	0.0
HIC	70.0	45.5	40.6	4.8
YP	125.7	65.3	55.4	10.0
BC	59.8	34.7	31.2	3.4
M	24.1	13.3	11.7	1.6
OTHERS	66.9	38.5	33.2	5.3
TOTALS	397.0	226.0	197.0	29.1
STD ERROR	47.2	36.0	33.2	2.8
PERCENT	11.9	15.9	16.9	9.6
CO VAR(%)	20.6	27.6	29.2	16.6
CORDS	136.7			

NO. POINT SAMPLES = 3

NO. ACRES IN TRACT = 10.0

the average per-acre estimates for the cruise, and tables 4 and 5 provide estimates for the tract.

Table 3. Per-acre biomass estimates for the cruise.

PER-ACRE BIOMASS ESTIMATES (TONS) FOR CRUISE

	TOTAL				MERCH.			
SPECIES	GREEN	DRY	W/O BARK	BARK	GREEN	DRY	W/O BARK	BARK
NRO	3.3	1.9	1.6	0.3	2.5	1.4	1.3	0.2
BO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WO	1.7	1.0	0.9	0.1	1.4	0.8	0.7	0.1
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HIC	7.0	4.5	4.1	0.5	5.3	3.5	3.1	0.3
YP	12.6	6.5	5.5	1.0	11.0	5.8	4.9	0.8
BC	6.0	3.5	3.1	0.3	5.0	2.9	2.7	0.3
M	2.4	1.3	1.2	0.2	1.9	1.1	0.9	0.1
OTHERS	6.7	3.9	3.3	0.5	5.3	3.1	2.7	0.4
TOTALS	39.7	22.6	19.7	2.9	32.5	18.5	16.3	2.2
CORDS	13.7				11.2			

NO. POINT SAMPLES = 3

NO. ACRES IN TRACT = 10.0

Table 5. Merchantable biomass estimates for the tract.

MERCH. BIOMASS ESTIMATES (TONS) FOR THE TRACT

SPECIES	GREEN	DRY	W/O BARK	BARK
NRO	25.4	14.5	12.6	1.9
BO	0.0	0.0	0.0	0.0
SO	0.0	0.0	0.0	0.0
WO	14.2	8.0	7.1	0.9
CO	0.0	0.0	0.0	0.0
HIC	53.5	34.8	31.4	3.4
YP	109.6	57.7	49.2	8.4
BC	50.0	29.4	26.5	2.8
M	19.0	10.6	9.4	1.2
OTHERS	53.1	30.5	26.8	3.8
TOTALS	324.9	185.4	163.2	22.3
STD ERROR	30.5	24.4	23.1	1.3
PERCENT	9.4	13.1	14.1	5.8
CO VAR(%)	16.3	22.7	24.5	10.1
CORDS	111.9			

NO. POINT SAMPLES = 3

NO. ACRES IN TRACT = 10.0

NORMAL TERMINATION EXIT

The standard error ($S_{\bar{x}}$) for the tract is calculated as:

$$S_{\bar{x}} = ((SX^2 - (SX)^2/n)/n(n-1))^{\frac{1}{2}}A$$

where: X = per-acre biomass estimate at a given point sample

n = number of point samples

A = acres in tract

The standard error is expressed as a percent of the tract estimates also.

The coefficient of variation (CO VAR) is useful for estimating the sample size required for a specified standard error in future cruises. It is calculated as:

$$\text{CO VAR } (\%) = ((((SX^2 - (SX)^2/n)/(n-1))^{\frac{1}{2}})/\bar{x})\ (100)$$

where: $\bar{x} = SX/n$

It should be noted that an unrealistically small point sample, with n = 3, was used for illustrations in tables 2-5. If point sampling factors are derived which are more appropriate in a given locality than those used here or are developed for other species, the FORTRAN program can be modified easily in the DATA FACTR1, DATA FACTR2, and DATA LABEL statements.

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THE NATIONAL RESOURCE INVENTORY TECHNIQUES PROJECT

One of the purposes of this newsletter is to report on the status of various research projects around the Nation involved in resources evaluation. The National Resource Inventory Techniques (NRIT) Project is one of the four research projects making up the Resources Evaluation Techniques (RET) Research and Development Program headquartered at the USDA Forest Service's Rocky Mountain Forest and Range Experiment Station in Fort Collins, Colorado. The mission of NRIT is to develop improved techniques for inventorying renewable natural resources, for and to transfer these techniques to appropriate users who generate state, regional, and national assessments. The project leader is H. Gyde Lund.

The current project problems include how to efficiently measure, sample, and aggregate soil, vegetation, and wildlife variables. The variables have been identified through information needs assessments for input to state, regional, and national assessments and corresponding analyses.

The short-range goals are to:

1. Develop by December 1981 criteria for evaluating the combinability of data from diverse sources for assessment purposes.
2. Evaluate by December 1981 alternative measurement and sampling techniques for soil and vegetation to improve ongoing renewable resource inventories for the National Assessment and Appraisals.
3. Develop by December 1981 a state-of-the-art paper on animal census techniques.

Our immediate research is to provide cooperating agencies with techniques that can be used to augment, strengthen, or modify their current procedures which will insure reliable and compatible data bases for national assessments.

The first goal has been partially completed through study 4154-1-1 on Aggregating Inventories. The preliminary results were published in Resources Evaluation Newsletter No. 4, Technical Article 1, p. 1-3, entitled, "Aggregating Inventories," by Lund and Schreuder.

A series of active studies are being conducted by project scientists to accomplish the second goal.

Study 4154-1-2, Plant Community Structure as an Ecological Base for Vegetation Inventory, will develop and evaluate techniques to measure vegetation variables required for national assessments. The lead scientist on this study is Richard E. Francis. The end product will be a list and explanation of techniques for measuring non-timber vegetation attributes.

Development and evaluation of techniques to obtain soils information for input to national assessments is the theme of Study RM-4154-1-3. The Project will draw upon the talents of Dale E. Snyder, Soil Conservation Service, assigned to the National Classification Project within the RET Program. The objectives of the study will be to determine the extent of soil surveys, the usefulness of soil survey data for national assessments, and how to obtain soils data in areas not surveyed.

Plot and Subplot Configurations for Resource Inventories are being explored by Meredith J. Morris under Study 4154-1-4. Morris is conducting an intensive literature review to evaluate and list the efficiency of alternative plot designs to capture the wide gamut of vegetation information required for national assessments.

Different sample designs have different advantages for assessments, land use planning, or single use. Lund, under study 4154-1-5, will

evaluate the efficiencies and considerations of grid (point) and area (polygon) sampling frames for use as input to national assessments.

Hans T. Schreuder, Leader of the Statistical Research and Support Group in the RET Program, is working with the NRIT to develop Sampling Strategies for Multiresource Inventories. Schreuder, through Study 4154-1-6, will develop sampling designs and estimators that are likely to be useful to agencies and also allow for measurement of additional needed variables for national assessments.

Goal three is new. Stephen A. Miller, recently assigned to the Project through the Interagency Personnel Agreement through the USDI Fish and Wildlife Service from the State of Maryland, is developing a state-of-the-art paper and problem analysis for animal census techniques. This will include procedures for estimating population numbers, age and sex composition, and mortality and natality rates.

Support is provided by Roger Kerbs, Range Technician, and Wally Greentree, Forest Technician.

Anyone wishing to correspond with the scientists on any of the above studies should write them directly c/o USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, CO 80526.

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INTERAGENCY WILDLIFE GROUP (IWG) ACTIVITIES

Cliff Hawkes, Dave Chalk, and Jim Whelan completed a problem analysis on Ecological Analysis Techniques for National Assessments of Wildlife and Fish for the National Resource Analysis Techniques (NRAT) Project. Comments and suggestions from the Forest Service, Fish and Wildlife Service, Soil Conservation Service, Bureau of Land Management, university faculty, and state wildlife and fish agency personnel were solicited, evaluated objectively, and incorporated into the final document. This problem analysis represents a cooperative effort which (1) identifies the major wildlife/fish problem areas of national concern to federal and state natural resource agencies, (2) describes the state-of-the-art for methodologies available to deal with the problems, and (3) identifies research needs and recommends research studies, in order of priority, which address each problem area.

In addition, the relationship between the wildlife/fish problem analysis and other problem analyses developed by the NRAT which deal with timber and range is described briefly. Each problem analysis constitutes an important part of an integrated resource analysis approach consistent with the cooperative nature of the Resource Evaluation Techniques Program and the Interagency (5-Way) Agreement related to Classification and Inventories of Natural Resources. The wildlife/fish problem analysis provides guidance in the selection and development of inventory procedures for collecting wildlife/fish information to be used in evaluating and monitoring the status of habitats and populations for national assessments.

A study plan for conducting an interagency information needs assessment for national and state level wildlife/fish resource planning was completed by Dave Chalk, Cliff Hawkes, Steve Miller, and Jim Whelan. This study will identify and define common interagency wildlife/fish resource information needs which will meet national and state level planning requirements of the cooperating federal and state agencies. The interagency information needs assessment will (1) define planning questions to be addressed by the 5-Way Agencies and the International Association of Fish and Wildlife Agencies (IAFWA), through the National Governor's Association/Council of State Planning Agencies, (2) determine information items and data elements needed to address the questions, and (3) develop definitions and standards for each information item and data element.

The chairman of the recently organized Wildlife Working Group component of the Canada Committee on Ecological Land Classification contacted the IWG and expressed an interest in our work. This Wildlife Working Group is the Canadian counterpart of the IWG. We are establishing good lines of communication between the two wildlife groups to improve cooperation in developing a hierarchical/ecological system for the classification, inventory, and analysis of wildlife and fish resources.

A paper on the function of the Interagency Wildlife Group was presented at the annual meeting of the Colorado Chapter of the Wildlife Society held in Fort Collins on January 29-30. A similar paper entitled Mission and Activities of the Resources Evaluation Techniques Interagency Wildlife Group was presented at the Colorado State University Wildlife Management Workshop held on January 19-23. Copies of both papers are available upon request from James B. Whelan, Chairman IWG, 3825 E. Mulberry, Fort Collins, Colorado 80524.

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CALL FOR PRESENTATIONS 1981 JOINT AIN/WIA NATIONAL WORKSHOP

The Association of Interpretive Naturalists and the Western Interpreters Association are calling for presentations for the Joint 1981 National Workshop to be held September 21-24 in Estes Park, Colorado.

Please consider the following areas for submission and review:

A. Papers describing empirical research in the area of interpretation, including relevant research in communications, landscape perception, human ecology, marketing/advertising, environmental psychology, and related fields. Papers should include an application of findings.

Submit papers no later than March 31 to:

Maureen McDonough
Department of Parks and Recreation Resources
131 Natural Resources Bldg.
Michigan State University
East Lansing, MI 48824
(517) 353-5190

B. Abstracts (250 words or less) related to all aspects of interpretation (natural, recreational, historical, etc.) at all levels (field operations, management, techniques). Specify the style of your presentation from the list below:
   1) General Presentation-normally 30 minutes
   2) Poster Board Demonstration - to be exhibited
   3) Short Comment - less than 5 minute presentation
   4) Panel Discussion - submit names and abstracts of each participant

Submit abstracts for review no later than March 31 to:

Peggy Van Ness
AIN
6700 Needwood Road
Derwood, MD 20855
(301) 948-8844

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SEVENTH CANADIAN SYMPOSIUM ON REMOTE SENSING, WINNIPEG, MANITOBA, CANADA

September 8-11, 1981

THEME: Down to Earth Management

Technical, plenary, and poster sessions, exhibits, and social events are planned. Deadline for technical paper abstracts is May 15, 1981.

Further information is available from the General Chairman, Mr. W. G. Best, c/o Department of Natural Resources, Manitoba Centre for Remote Sensing, 1007 Century Street, Winnipeg, Manitoba, Canada, R3H OW4.

This symposium is sponsored by the Canadian Remote Sensing Society of the Canadian Aeronautical Space Institute, and organized by the Manitoba Branch of the Canadian Institute of Surveying.

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PURDUE HOSTS EDUCATORS' CONFERENCE

CORSE-81, Conference on Remote Sensing Education, will be held May 19-21, 1981, at Purdue University. Co-sponsored by NASA and NOAA, the conference is being organized and conducted by the Laboratory for Applications of Remote Sensing (LARS).

The goal of the conference is to bring together remote sensing educators from across the country to exchange information on establishing and improving remote sensing curricula in institutions of higher education.

A panel presentation during the opening session will seek to identify the kinds of skills and knowledge that will be needed by those involved in remote sensing in the years ahead. The remainder of the conference will explore ways for education to meet this challenge.

An honest look at resources needed for effective teaching of remote sensing and also at strategies for teaching in various disciplines will lead into concurrent, discipline-oriented sessions where educators can tackle specific problems in small groups. Several presentations and discussions will also address critical questions about obtaining and using digital image-processing capabilities for education.

Several tutorial workshops will be held in conjunction with the conference. These workshops, on the days preceding and following the conference, will serve to acquaint relative newcomers with the basics of remote sensing, and will be a means for others to keep abreast of new technological developments.

Attendance at CORSE-81 is limited to approximately 200 educators, with room and meals provided for many who attend. For additional information contact Shirley Davis, Laboratory for Applications of Remote Sensing, Purdue University, 1220 Potter Drive, West Lafayette, Indiana 47906, Phone (317) 749-2052.

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CURRENT LITERATURE

Please order directly from sources given in (   ). In case of journal articles, contact your local library for availability.

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NASA. 1980. Earth Resources, a continuing bibliography with indexes. NASA SP-7041(26). 126 p. (National Technical Information Service, Springfield, VA 22161. $10.50).

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Hoffer, R. M., et al. 1979. Digital processing of Landsat MSS and topographic data to improve capabilities for computerized mapping of forest cover types. LARS Technical Report 011579. 159 p. (Contact LARS, Purdue University, West Lafayette, IN 47906, for availability).

Nelson, Ross F., and Roger M. Hoffer. 1979. Computer-aided processing of Landsat MSS data for classification of forestlands. LARS Technical Report 102679. 94 p. (Contact LARS, Purdue University, West Lafayette, IN 47906, for availability).

Befort, W. A., R. C. Heller, and J. J. Ulliman. 1980. Updating forest road maps with panoramic aerial photography. Contribution No. 194. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID 83843). 11 p.

Befort, W. A., R. C. Heller, and J. J. Ulliman. 1980. Viewing and handling panoramic aerial photographs. Technical Report 7. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID 83843). 16 p.

Hinkle, R. E., et al., Lockheed Eng. and Mgmt. Ser. Co., Inc., 1980. Mount St. Helens Quick Response Damage Assessment Final Report. (Contact NFAP, USDA, 1050 Bay Area Blvd., Houston TX 77058, for availability). 39 p.

Aldrich, Robert C. 1978. A national multiresource inventory system: Possibilities, problems, and progress. 7 p. (This and three following available from Remote Sensing Project, RET, Rocky Mountain Forest and Range Exp. Stn., 240 West Prospect St., Ft. Collins, CO 80526).

Aldrich, Robert C. 1979. Satisfying multiresource information needs for national assessments--a challenge for remote sensing. 15 p.

Aldrich, Robert C. 1979. Sampling for multiresource information--can aerial photographs help and at what cost? 13 p.

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MEETINGS, WORKSHOPS, AND SYMPOSIA

March 30-April 3, 1981. Remote Sensing for Global Resource Applications: Principles and Techniques. Course No. 488. $695. Contact: Continuing Engineering Education, George Washington University, Washington, D. C. 20052. Phone (202) 676-6106.

April 6-10, 1981. Digital Image Processing of Earth Observation Sensor Data. Course No. 307. $695. Contact: Continuing Engineering Education, George Washington University, Washington, D. C. 20052. Phone (202) 676-6106.

April 6-11, 1981. Perspectives in Landscape Ecology: Contributions to Research, Planning and Management of Our Environment. (Eindhoven, The Netherlands). Contact: Ms. W.J.M. van Giersbergen, Congress Bureau of the Information Dept. TNO, 148, Juliana van Stolberglaan, 2595 CL The Hague - The Netherlands.

April 18-19, 1981. Remote Sensing Workshop. (Los Angeles, CA) Held in conjunction with Seventy-first Annual Meeting of Association of American Geographers. Contact: Ronald A. Weinkauf, Dept. of Geography and Earth Science, Univ. of Wisconsin, La Crosse, WI 54601. Phone (608) 785-8340.

April 20-23, 1981. Energy and Ecological Modelling - An International Symposium. Contact: Dr. William J. Mitsch or Dr. Robert W. Bosserman, Systems Science Institute, Univ. of Louisville, Louisville, KY 40292. Phone (502) 588-6482.

April 21-23, 1981. Eighth Biennial Workshop on Color Aerial Photography in the Plant Sciences and Related Fields. (Shenandoah National Park, Virginia). Contact: Dr. Roy A. Mead, Program Chairman, VPI and State Univ., Blacksburg, VA 24061. Phone (703) 961-5481.

April 22-24, 1981. Forest Sampling Short Course. (F8105). Sponsored by Forestry Off-Campus Programs, University of British Columbia and Continuing Forestry Education, University of Alberta. Contact: Forestry Off-Campus Programs, Room 72, 2357 Main Mall, University of British Columbia, Vancouver, B.C. V6T 1W5 Canada. Phone (604) 228-6108/6821.

April 23, 1981. Methods for Controlling Development of Crowns, Boles, and Stands (F8106). Sponsored by Forestry Off-Campus Programs. Contact: Forestry Off-Campus Programs, Room 72, 2357 Main Mall, University of British Columbia, Vancouver, B.C. V6T 1W5 Canada. Phone (604) 228-6108/228-6821.

May 3-6, 1981. Wildlife Management on Private Lands. Milwaukee, WI. Contact: Robert T. Dumke, 3911 Fish Hatchery Rd., Madison, WI 53711. Phone (608) 266-8607.

May 4-15, 1981. Forest Industries Management Development Program. $1,900. Includes all fees, meals, and lodging. Contact: Management Development Programs, 708 Stokely Management Center, Univ. of Tennessee, Knoxville, TN 37916.

May 11-15, 1981. Fifteenth International Symposium on Remote Sensing of Environment. Contact: Dr. Jerald J. Cook, ERIM, P. O. Box 8618, Ann Arbor, MI 48107. Phone (313) 994-1200.

May 26-28, 1981. The Ninth Annual Hardwood Symposium, "Research Today is the Key to Profitability Tomorrow." (Pipestem, West Virginia). Contact: Hardwood Research Council, P. O. Box 131, Asheville, NC 28802. Phone (704) 254-2682.

June 1-5, 1981. Remote Sensing Techniques in Geology. Contact: Branch of Applications, EROS Data Center, Sioux Falls, SD 57198. Phone (605) 594-6114.

June 13-August 28, 1981. A series of short courses are available on The Natural Phenomena of the Yellowstone Area. For more information, contact Rick Reese, Director, The Yellowstone Institute, 555 South Roberts, Helena, MT 59601. Phone (406) 443-0861.

June 22-26, 1981. Dynamics and Management of Mediterranean-type Ecosystems: An International Symposium. (San Diego, California). Contact: Chairman, Dynamics and Management of Mediterranean-type Ecosystems: An International Symposium, Pacific Southwest Forest and Range Exp. Stn., USDA Forest Service, 4955 Canyon Crest Drive, Riverside, CA 92507.

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June 23-26, 1981. Symposium on Machine Processing of Remotely Sensed Data - Special Emphasis on Forest, Range, and Wetland Assessment. Contact: Douglas B. Morrison, Purdue University/LARS, 1220 Potter Drive, West Lafayette, IN 47906. Phone (317) 749-2052.

June 26-October 2, 1981. Ninth Forest Research Course of the Commonwealth Forestry Institute. Contact: H. L. Wright, Dept. of Forest Science, Commonwealth Forestry Institute, Univ. of Oxford, Oxford, OX1 3RB, England.

July 7-10, 1981. Use of Programable Calculators in Forestry. $400.

July 13-17, 1981. Regression Methods in Resource Analysis. $400.

July 20-24, 1981. Multilevel Sampling. $400. For information on all three of the above short courses, contact Offices of Conferences and Institutes, W1 Rockwell Hall, Colorado State University, Fort Collins, CO 80523.

August 9-14, 1981. "In-Place Resource Inventories: Principles and Practices--A National Workshop." (Orono, Maine). $60. Sponsored by The Renewable Natural Resources Foundation, the Society of American Foresters, Society for Range Management, American Society of Photogrammetry, Wildlife Society, and in cooperation with the Forest Industries of Maine, University of Maine, the USDA Forest Service, Soil Conservation Service, USDI Bureau of Land Management, Fish and Wildlife Service, and Geological Survey. Contact: John Benoit, Conferences and Institutes Div., University of Maine, 128 College Ave., Orono, ME 04473. Phone (207) 581-2626.

October 13-24, 1981. International Geologic Correlation Programme (IGCP) Workshop on Remote Sensing and Mineral Exploration. (Nairobi, Kenya). Contact: W. D. Carter, U.S. Geological Survey, National Center, Mail Stop 730, Reston, VA 22092.

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WANTED--Materials for the Newsletter--feature articles, news items, current literature, and meeting notices. All articles received are to be grammatically and technically correct. Send your material to Resources Evaluation Newsletter, Rocky Mountain Forest and Range Exp. Stn., 240 West Prospect Street, Ft. Collins, CO 80526. Phone: (303) 221-4390, ext. 202 or FTS 323-1202.

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Views expressed in this Newsletter may not necessarily reflect the position of some of the sponsoring agencies.